COAL GASIFICATION

To

State of Utah Senate Committee
Natural Resources, Agriculture, Environment

Dr. L. Douglas Smoot
BYU Professor Emeritus
Senior Consultant, Combustion Resources, Inc.

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General Comments on U.S. Energy Directions

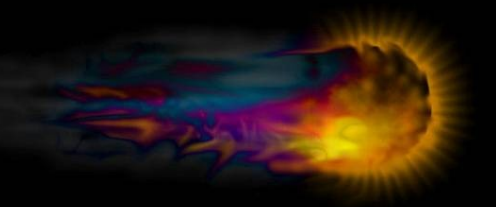
- Complicated Issue
  - U.S. Strategic Dependence
  - Many Energy Sources at Various States of Readiness and Capabilities
  - World Cost Competitiveness
  - U.S. Economy Implications
  - Wind, Solar not Continuous
  - Global Warming Implications
- Strong, Extreme Environmental Lobby
- Partial, Often Biased , Published Information
- Staggering Cost Infrastructure
- Continuing Need for Fossil Fuels (Currently 85%)

Projected Energy Trends to 2030
EIA Annual Energy Outlook 2008

Energy Source	% of Total	
	2006	2030
1. Total Fossil Fuels	85	80
2. Imported Oil/LNG	30	25
3. Renewable (wind, biomass)	7	13
4. Nuclear	8	8
5. Alternative	0	1
U.S. Consumption (10^{15} BTU)	100	**118 (3/4 of 1%)**
U.S. CO_2 Emissions, 10^6 tonnes	6000	**6800 (1/2 of 1%)**

To Provide 10% of Total U.S. Energy Needs (11.8 Q) by 2030

- Nuclear – Build 212 plants – 1,000 MW
- Oil Shale – Build 4,000 plants – 25,000 bbl/day
- Wind – Install 26,000 wind turbines, 3 MW (12 hrs/day)
- Biomass – Harvest 140,000 acres/day



What is Coal Gasification?

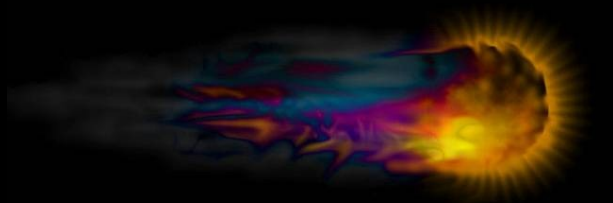
Coal Combustion (Completely Burned)

$$\text{Coal (CH)} + 1.25\ O_2 \rightarrow CO_2 + H_2O$$

Coal Gasification (Partially Burned – Fuel-Rich Products)

$$\text{Coal (CH)} + 0.5\ O_2 \rightarrow CO + \tfrac{1}{2}\ H_2$$

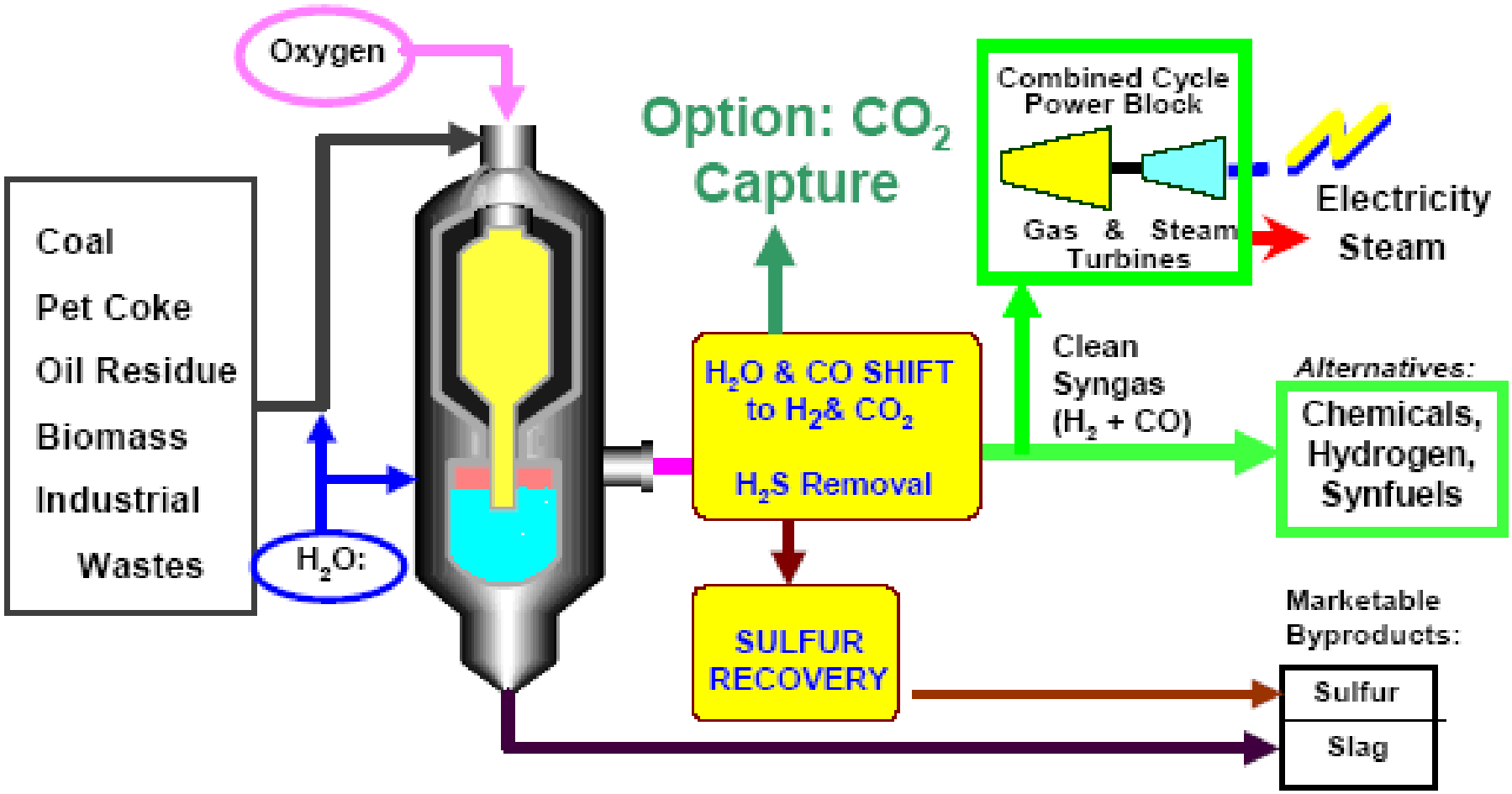
Coal Gasification ⇨ FUEL-RICH COMBUSTION.



Coal Gasification Development Has Been On-Going Since the 1940s

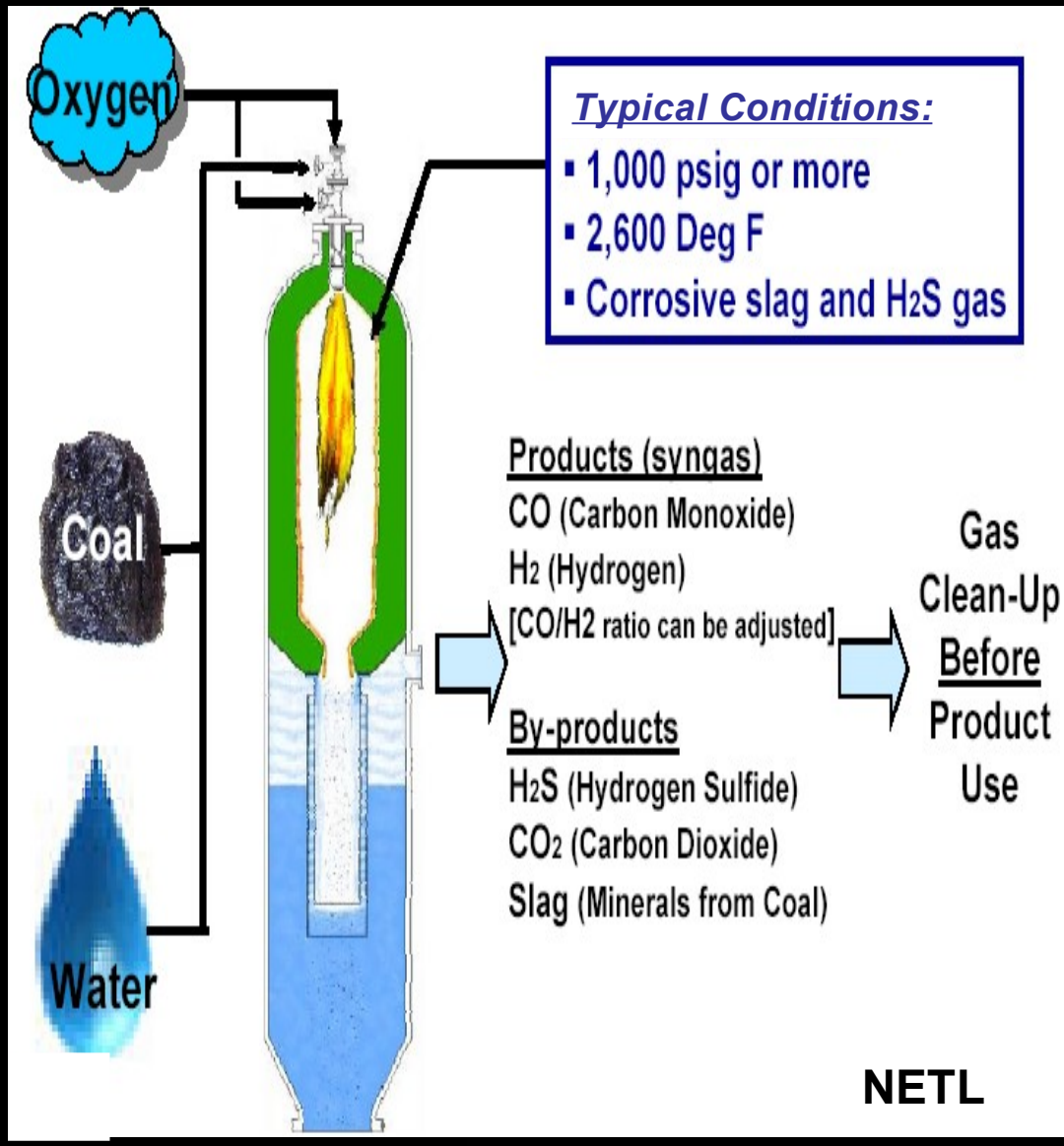
- (Lurgi - Germany – World War II – Liquid Fuels)
- South Africa - Commercial Liquids Production – 180,000 bbl/day – Decades
- U.S. Clean Coal Technology Program 1986-2005 (5.2 billion)

Gasification - Flexible
Feedstocks, Products



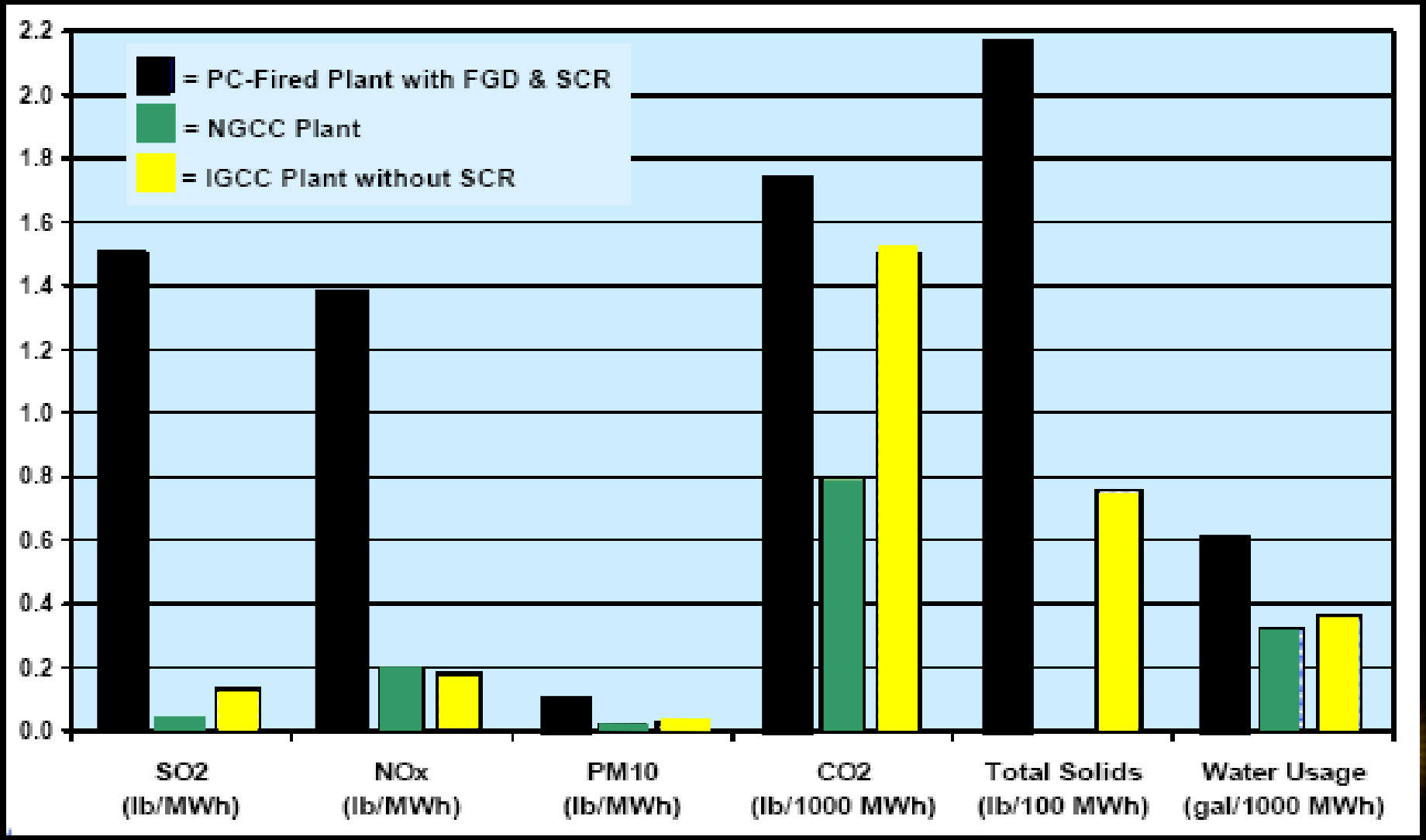
Coal Gasification Potential

- Much higher efficiency (IGCC)
- Greatly reduced emissions
- Reduced or eliminated global warming gas (CO_2)
- Flexible Products
  - Power
  - Transportation fuel
  - Syngas, H_2
- Continued use of vast reserves of coal



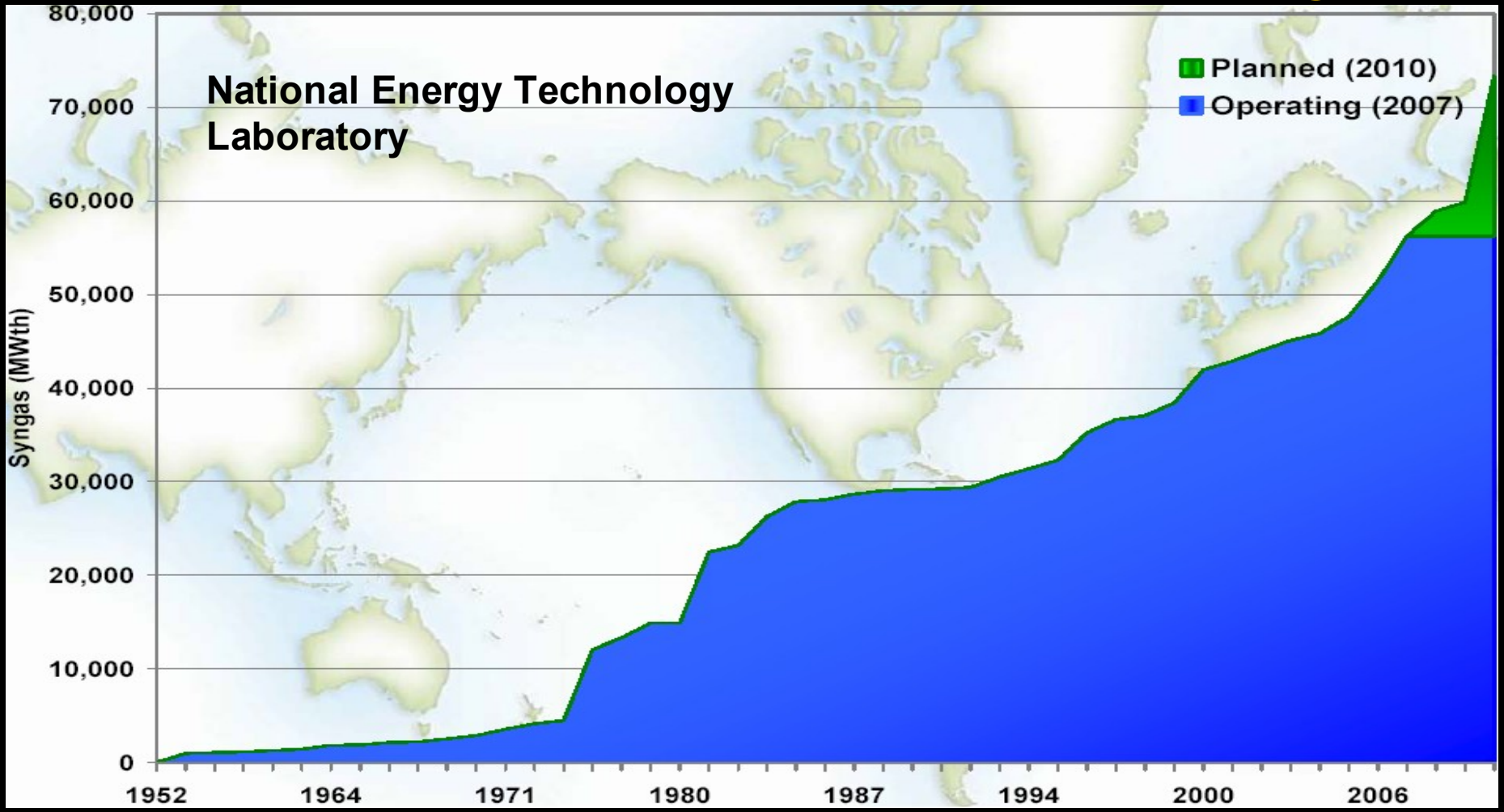
Comparison of Environmental Factors

Pulverized Coal-Fired, NGCC and IGCC Plants



G Stiegel-NETL

Worldwide Gasification Capacity



- > 140 gasification plants.
- > 420 gasifiers.
- Nineteen plants - United States.
- 70 % growth – 2015 (80% in Asia)

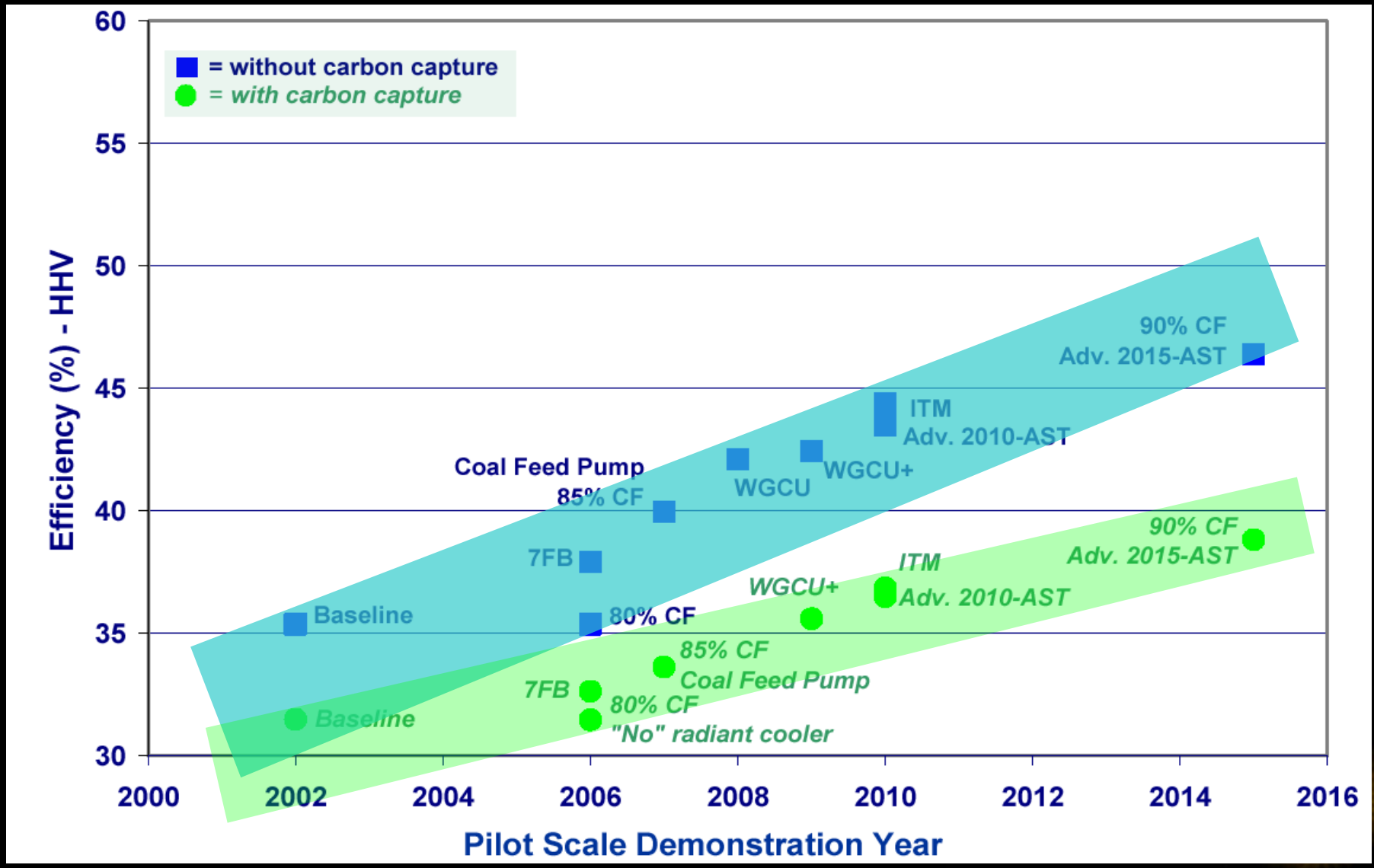
- Uses:
  - Chemical, Fertilizer, Coal-to-liquid
  - Oil sand
  - Hydrogen and power, SNG
  - Refining

NETL

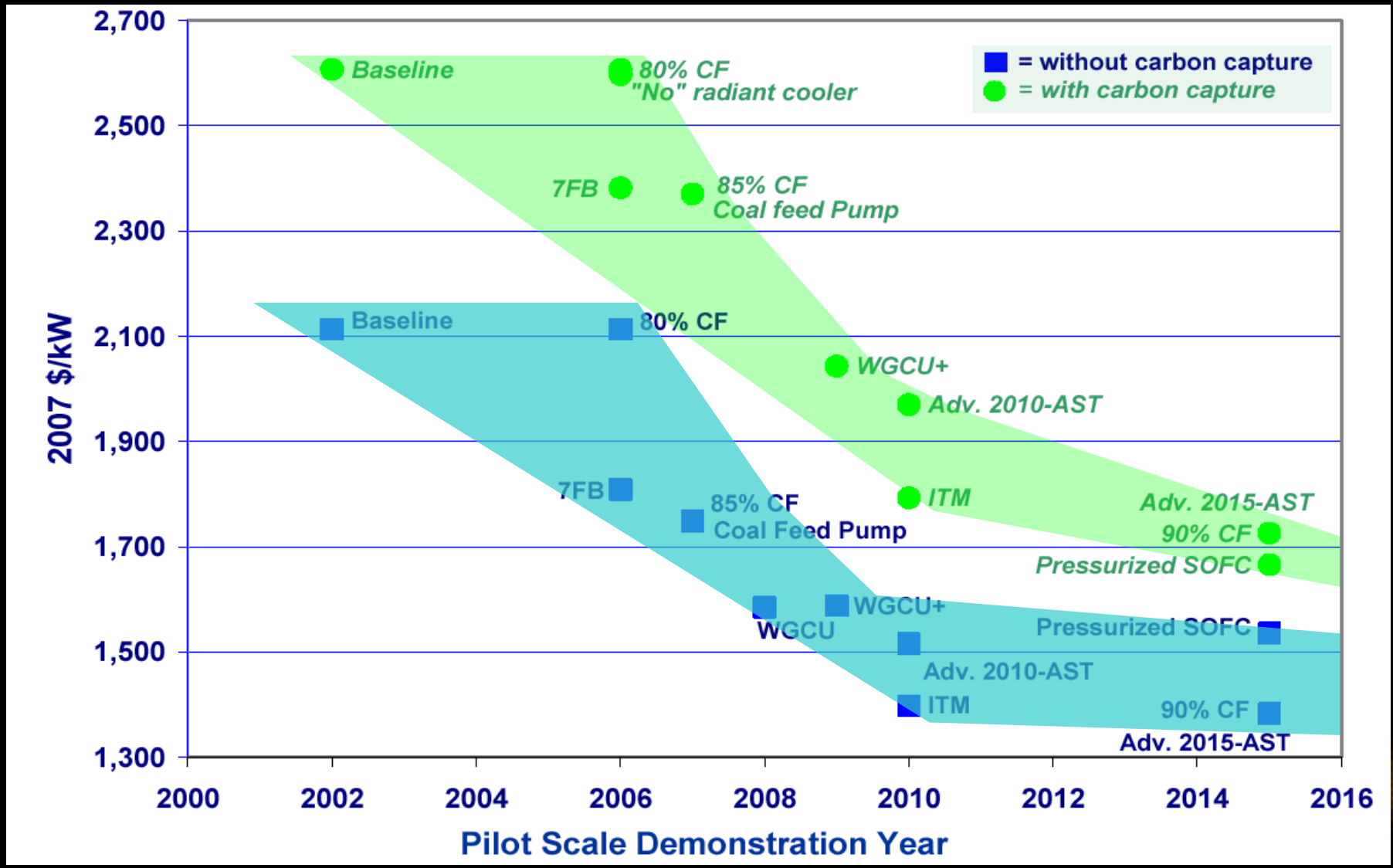
U.S. Coal Gasification Expansion

- Currently, 19 plants, 1977-2002, one power plant.
- Slowed by Environmental Concerns – CO_2
- 15 Plants Cancelled since 2002 (DOE, Dec 2008)
- 41 Proposed Plants for service (2008 - 2014)
- Coal Gasification – A key in U.S. Department of Energy Plan - 45 to 50 percent electrical efficiency - $1,600 per kilowatt – Environmental and efficiency benefits

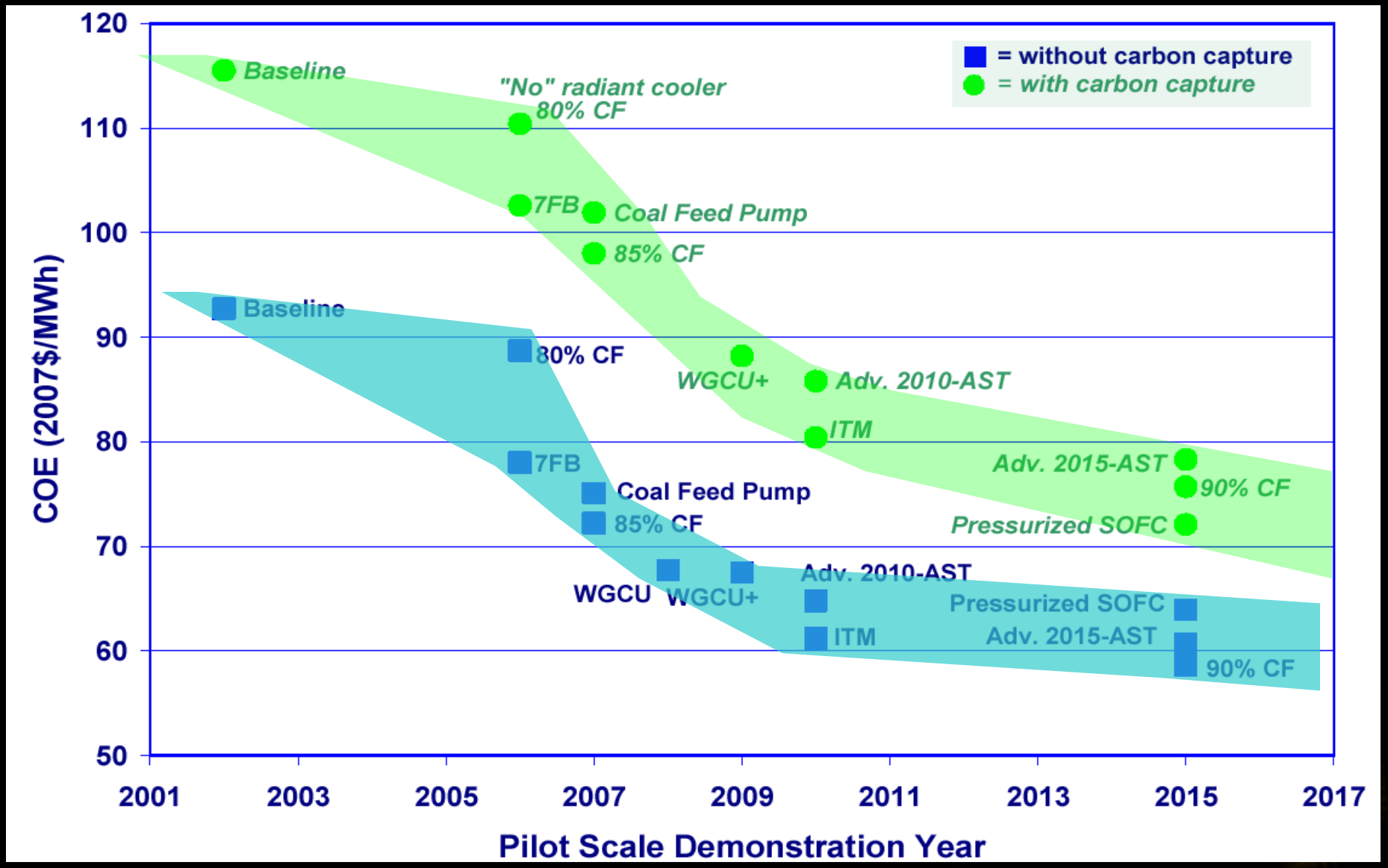
Efficiency Timeline



Capital Cost (2007$/kW) Timeline

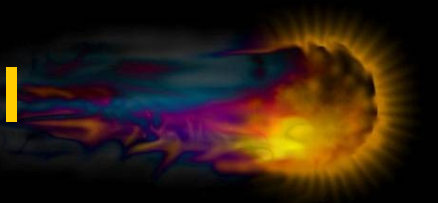


COE Timeline



CO_2 Capture/Disposal (CCS)

- All Fossil Fuels Produce CO_2
- Natural gas-CH_4; Gasoline-CH_2; Coal-CH
- With CO_2 Capture – Nearly Commercial Technology - Reduce CO_2> 90%
- Goal - 99% storage permanence (DOE, 2009)
- CO_2 for:
  - Secondary Oil Recovery – Commercial
  - Sequestration – In development
  - Algae Growth – Conceptual



CO_2 Capture/Disposal (CCS)

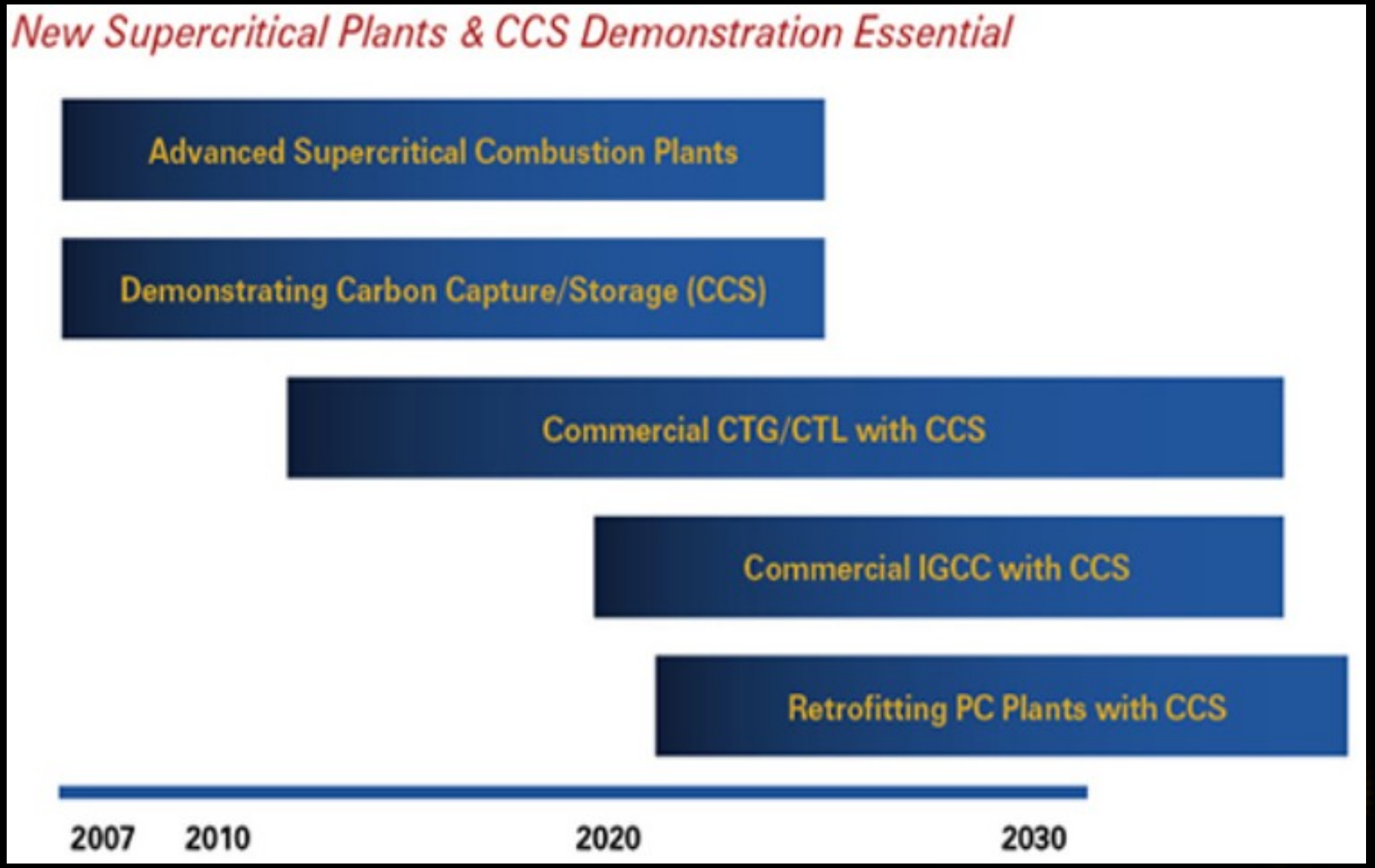
Continued…

- CO_2 Sequestration – Major U.S./ DOE Effort
  - IEA – Worlds Largest Program
  - Seven DOE Regional Partnerships
  - Three Regions 315 M

- Accelerated Investment
  - 2008 Energy bill $1.5 B, 65-75 % CO_2 reduction – 10 years
  - 2009 Stimulus $2.4 B, 90 % CO_2 capture - 10 years
  - Geologic CO_2 Sequestration Training and Research - FOA $20 million

- Projected Commercial – one to two decades (DOE; WBC, 2006)
  - By 2020 - Commercial Deployment Technologies - 90% CO_2 capture

The Green Coal Path to Near-Zero Emissions with Coal



Clean Coal: America's Energy Future, Dec 2008

Summary

- Use of Coal Essential – Key Part of DOE Plan
- Coal Gasification and Coal Combustion Viable
- Coal Gasification and CO_2 Capture Commercial
- U.S. Major Effort on CO_2 Storage from Coal
- Extreme Environmental Lobby Curtailing Expansion of Coal Use and Gasification

Thanks for the opportunity

To discuss

Coal Gasification Technology

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